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Sekiguchi

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(54) **INJECTION DEVICE**

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CPC ***B29C 45/18*** (2013.01); ***B29B 13/065*** (2013.01)

(58) **Field of Classification Search**
CPC B29C 45/18; B29C 13/065; B29C 2045/1875; B29C 31/004; B29C 31/02;
(Continued)

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(Continued)

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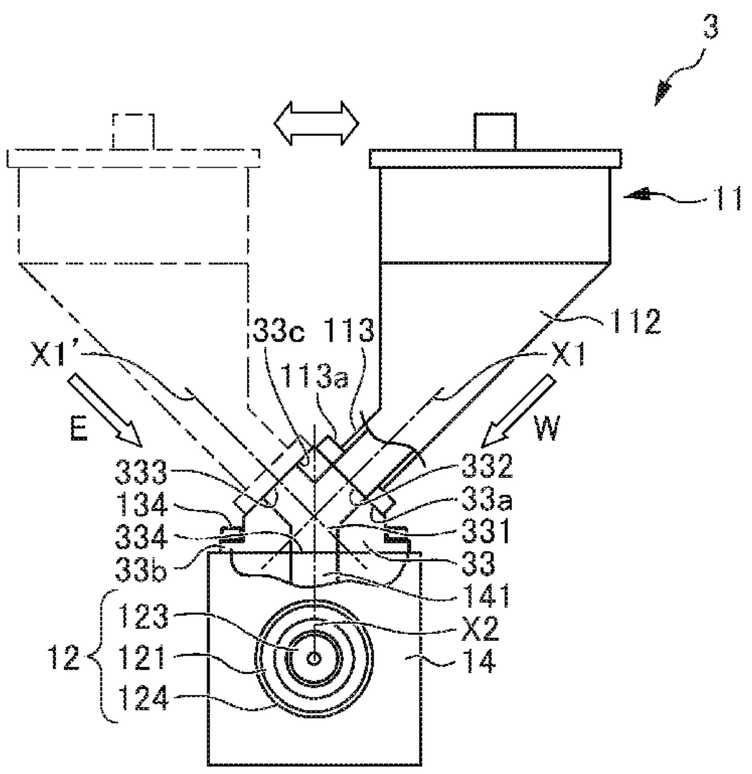
(57) **ABSTRACT**

An injection device is provided with high convenience by the degrees of freedom in layout of a storage unit and peripheral equipment increasing by way of providing a supply unit with changeable supply direction of molding material. An injection device includes: a hopper that stores a molding material; an injection cylinder unit that heats the molding material to melt, and then injects the molding material thus melted; and a supply unit having formed inside thereof a supply hole for supplying the molding material stored in the hopper to the injection cylinder unit, in which the supply unit is fixed so that a position and orientation of an opening of the supply hole on a side of the hopper is changeable relative to the injection cylinder unit.

5 Claims, 9 Drawing Sheets



(58) **Field of Classification Search**
CPC B29C 48/684; B29C 48/2567; B29C 48/2563; B29B 13/065
See application file for complete search history.

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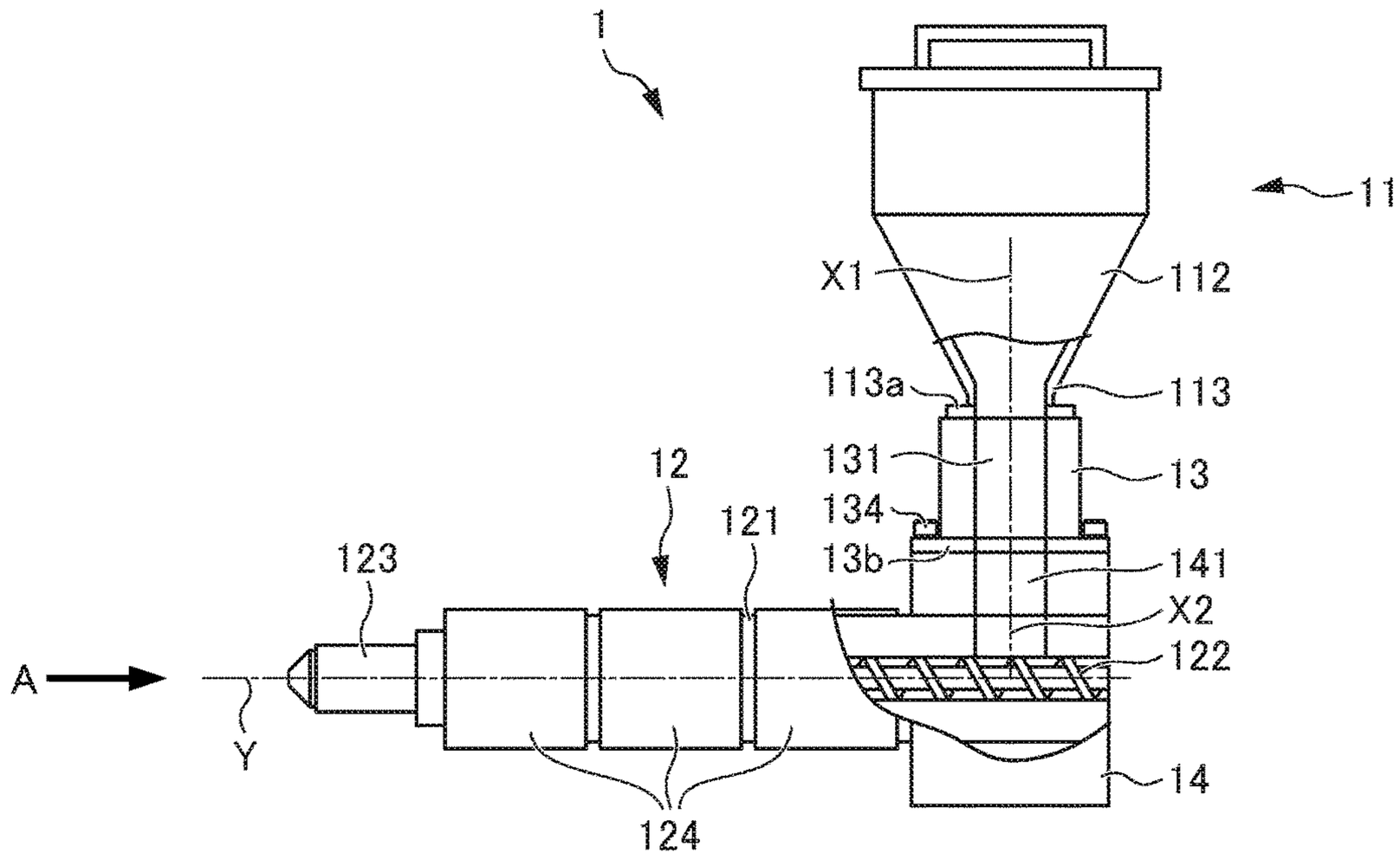
FIG. 1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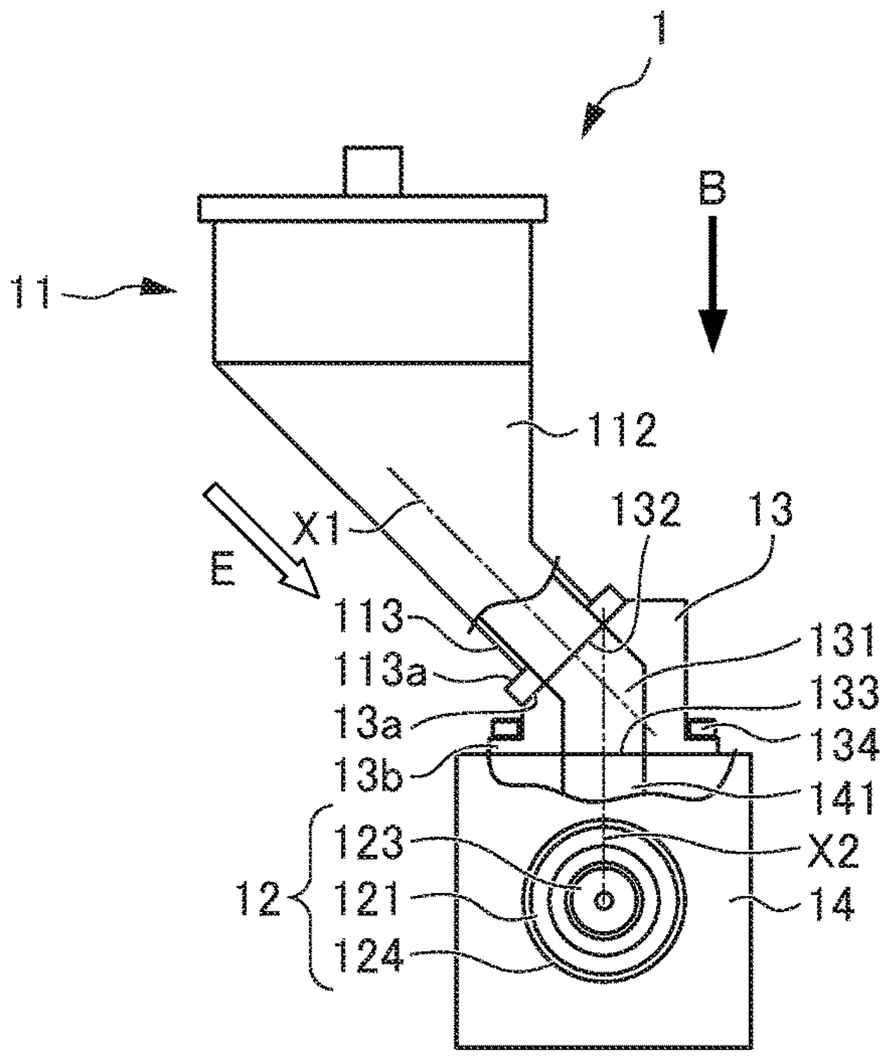
11
X1
112
113a
113
131
13
12
134
121
13b
141
123
X2
A
122
Y
14
124

FIG. 2A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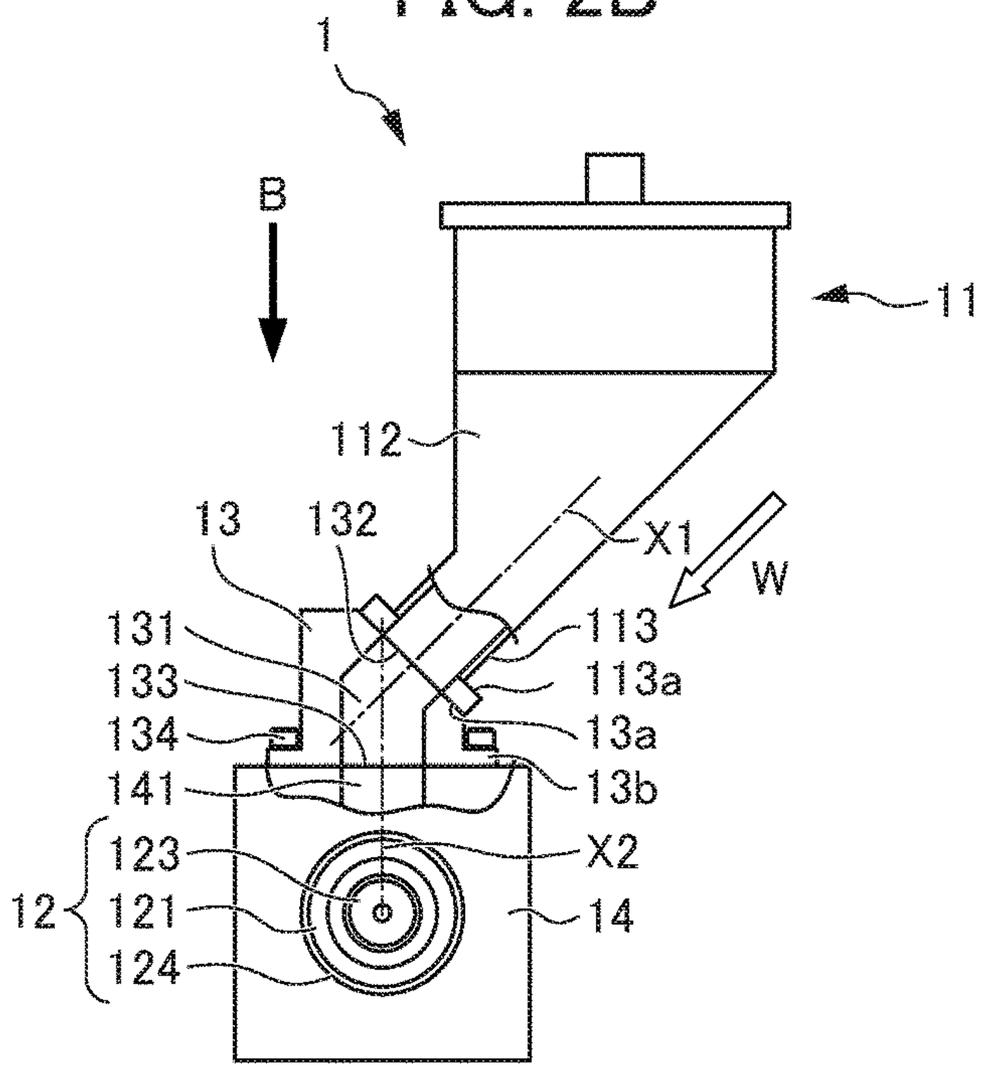
14
124

FIG. 2B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112
13
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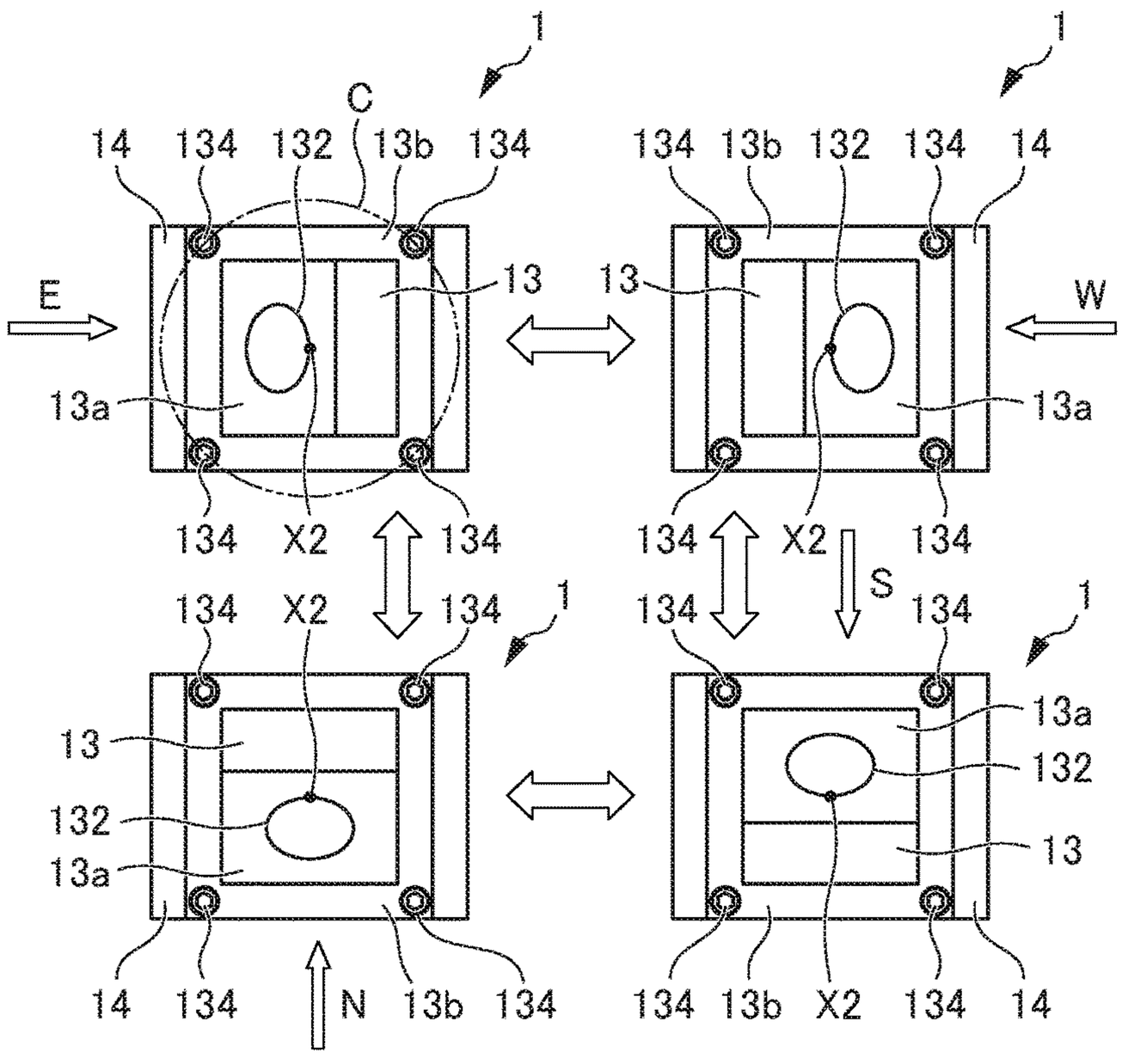
13b
123
X2
12
121
14
124

FIG. 3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13a
14
134
N
13b
134
1
134
13b
132
134
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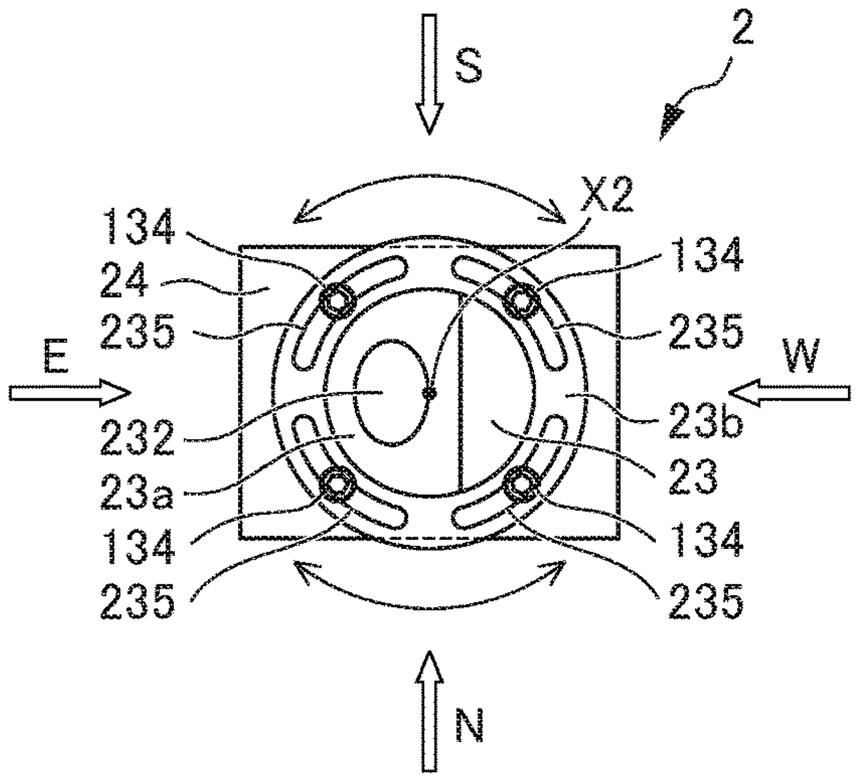
132
13
134
13b
X2
134
14

FIG. 4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E
232
23a
134
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134
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W
23b
23
134
235
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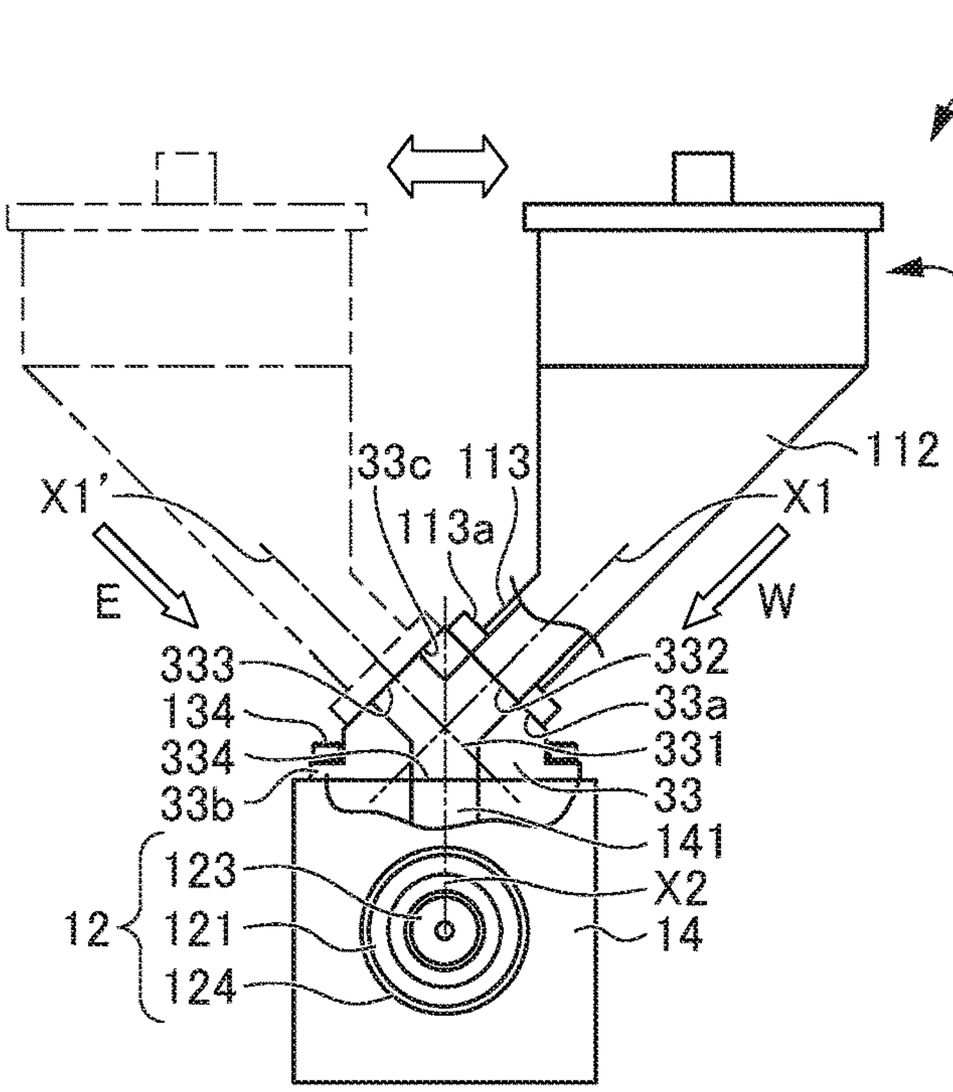
FIG. 5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112
33c 113
113a
X1'
X1
E
W
333
134
334
33b
332
33a
331
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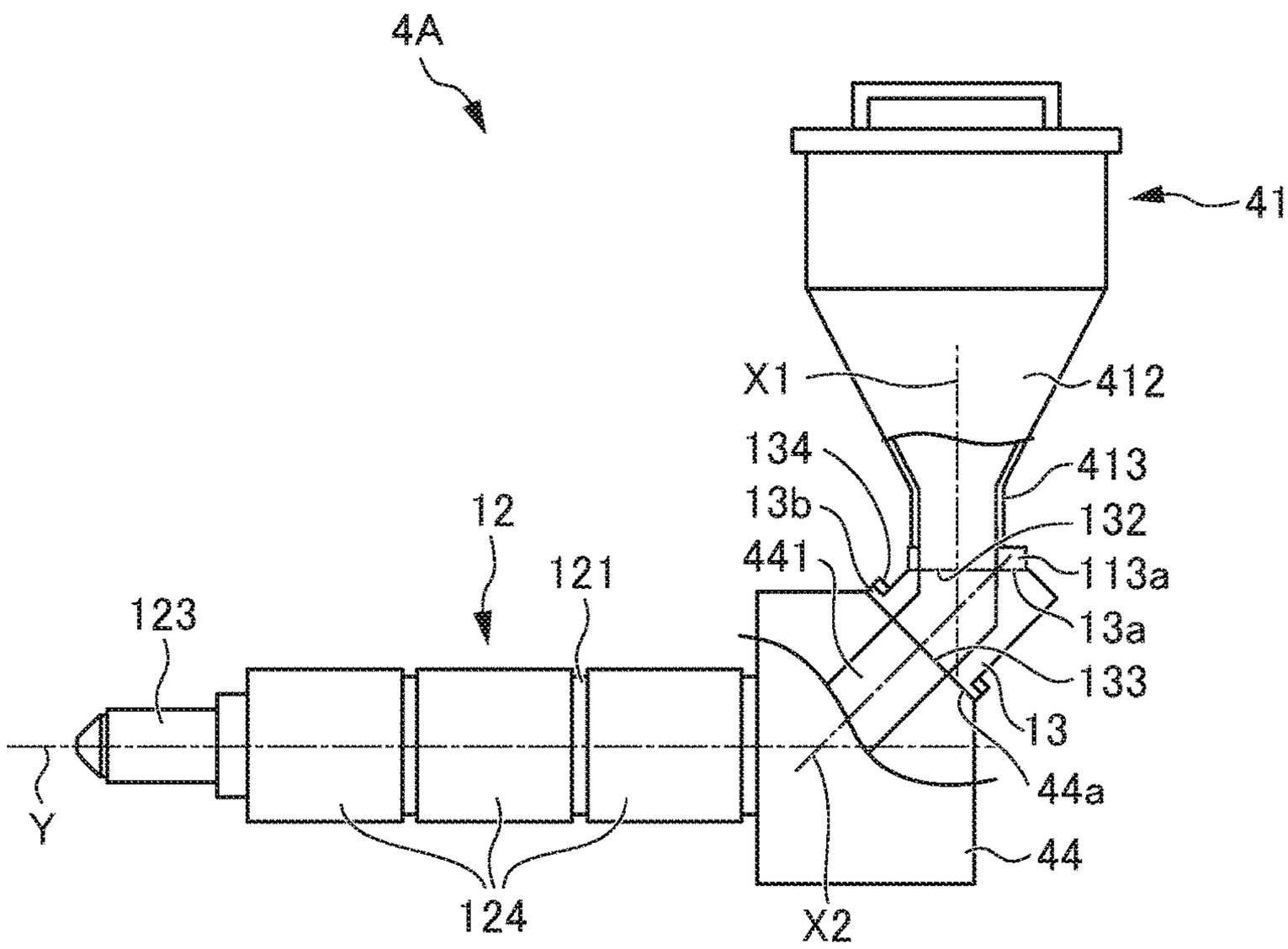
141
X2
14
12
123
121
124

FIG. 6A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13a
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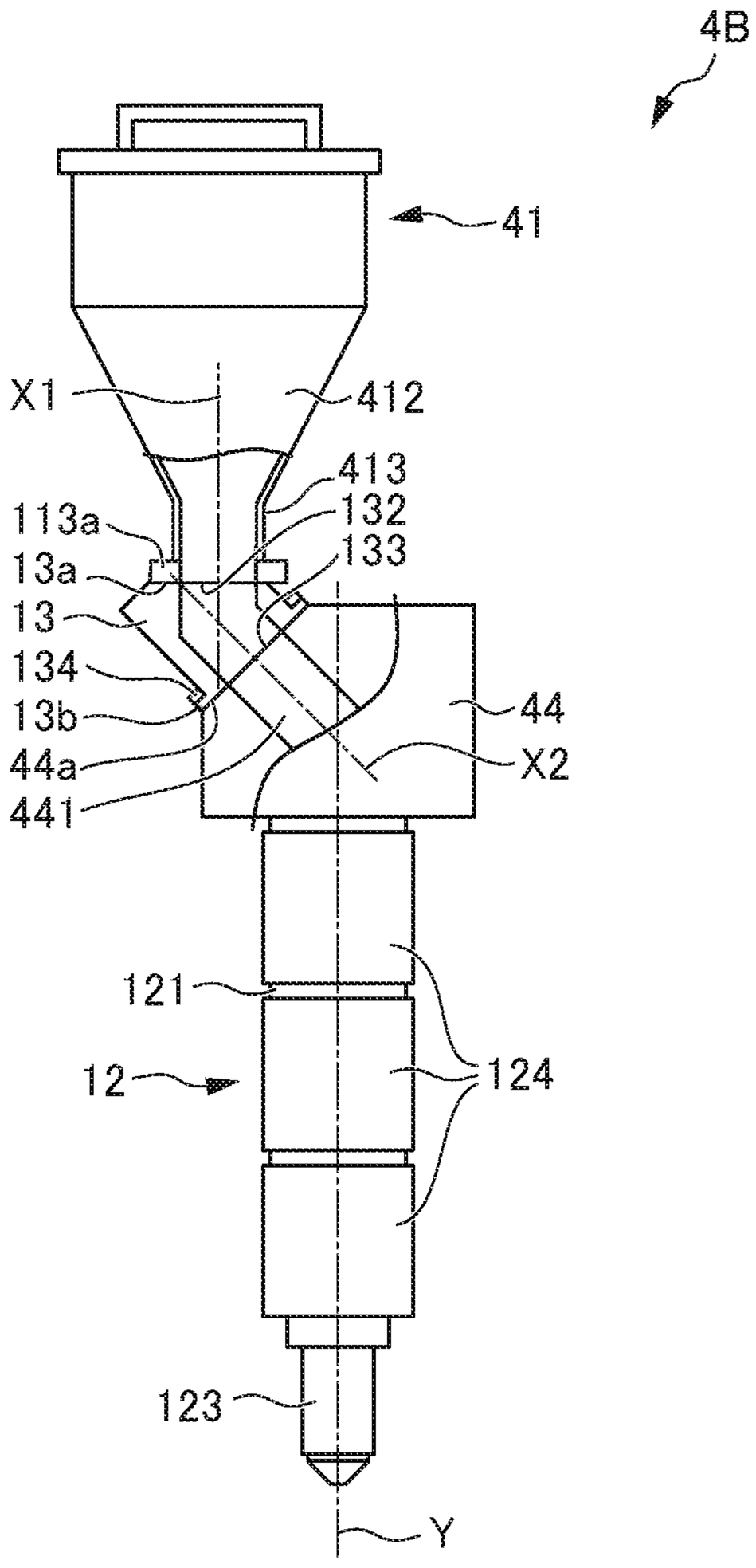
13
Y
44a
44
124
X2

FIG. 6B


4B
41
X1
412
413
113a
132
13a
133
13
134
13b
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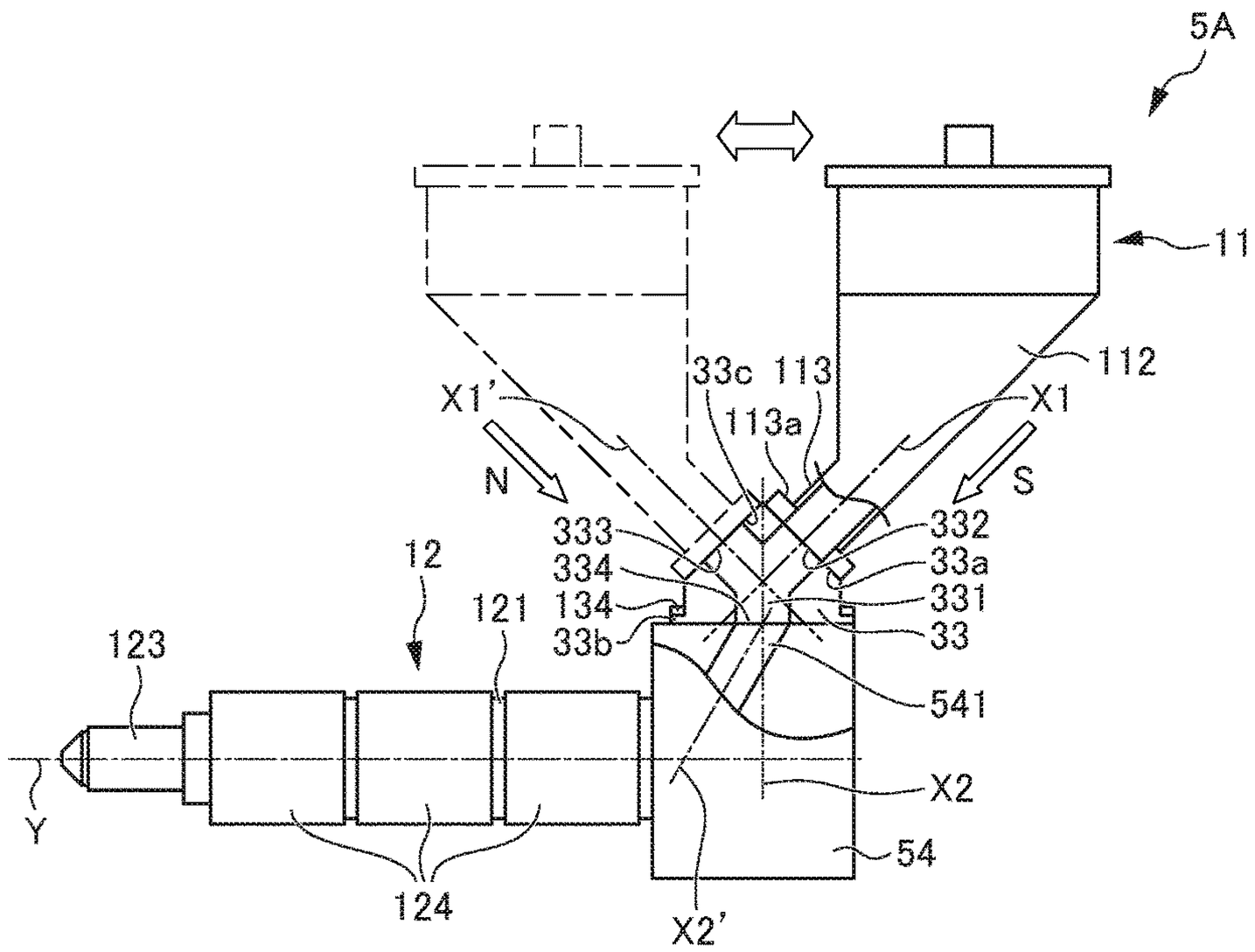
44a
X2
441
121
12
124
123
Y

FIG. 7A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11
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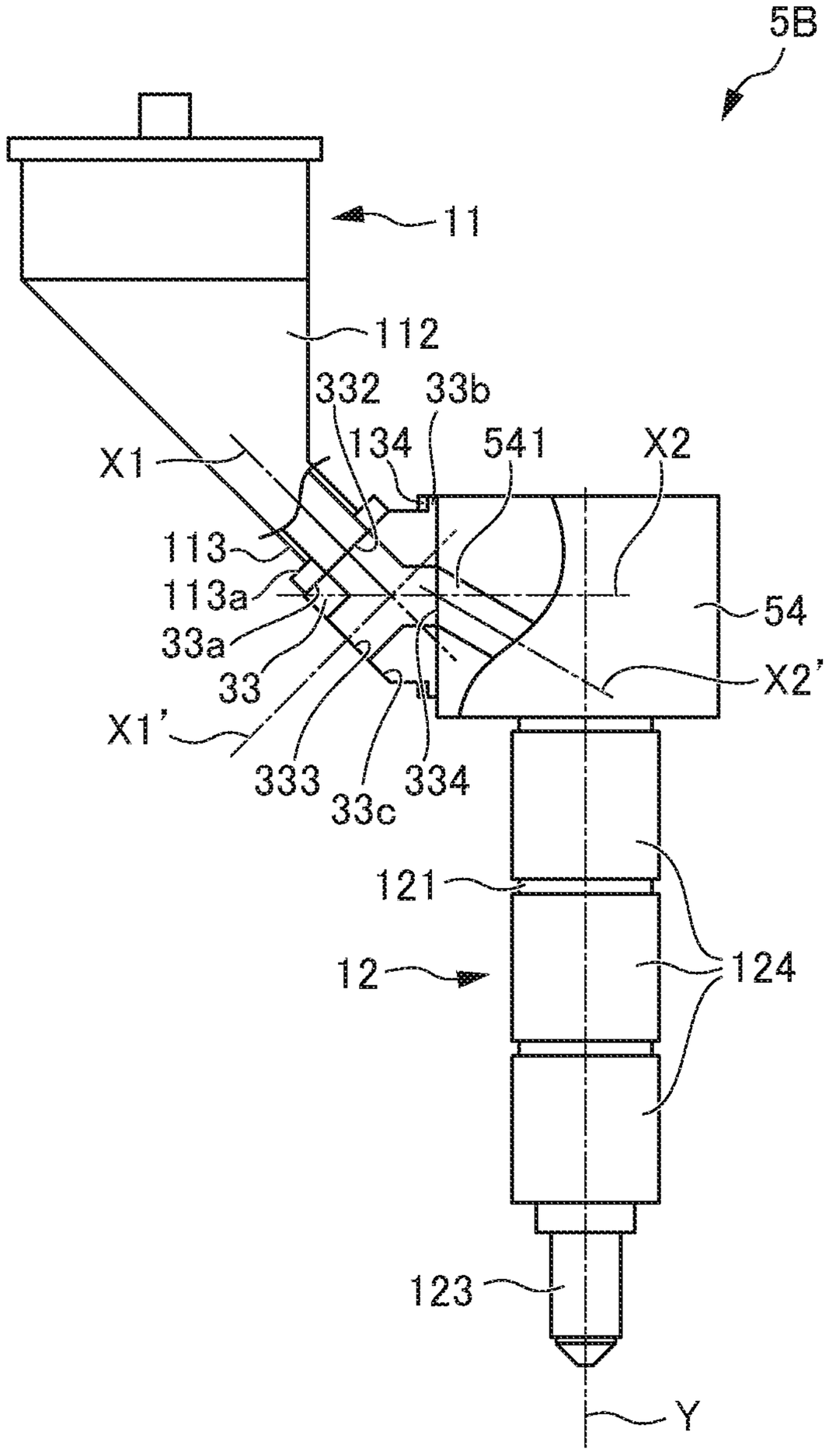
X1'
X1
33c
113
113a
N
S
333
332
334
33a
12
121
134
331
33b
33
123
541
X2
Y
54
124
X2'

FIG. 7B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33b
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X1
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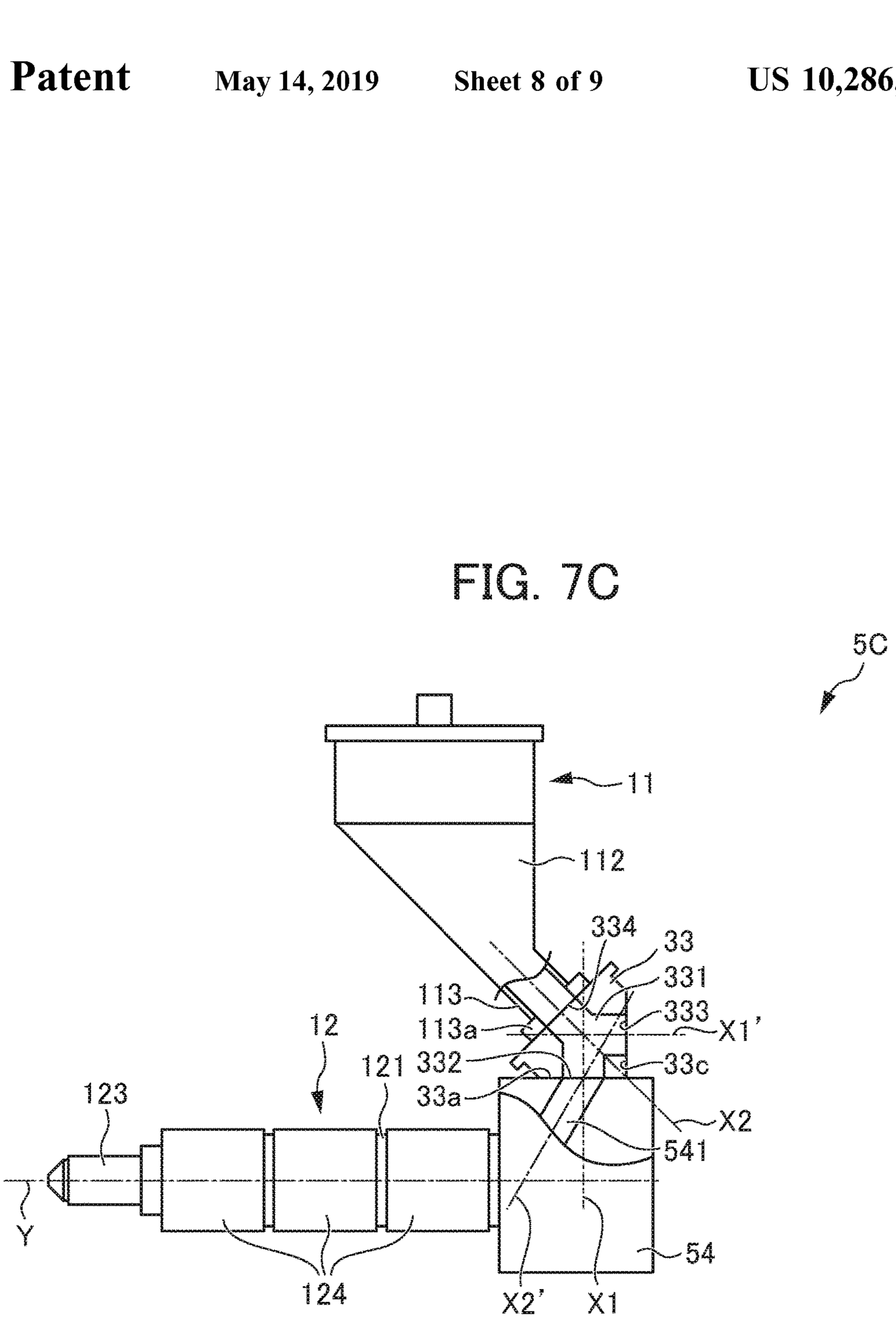
33a
X2'
33
X1'
333
33c
334
121
12
124
123
Y

FIG. 7C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112
334
33
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333
X1'
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113a
332
33c
33a
12
121
123
X2
541
54
Y
124
X2'
X1

FIG. 8A

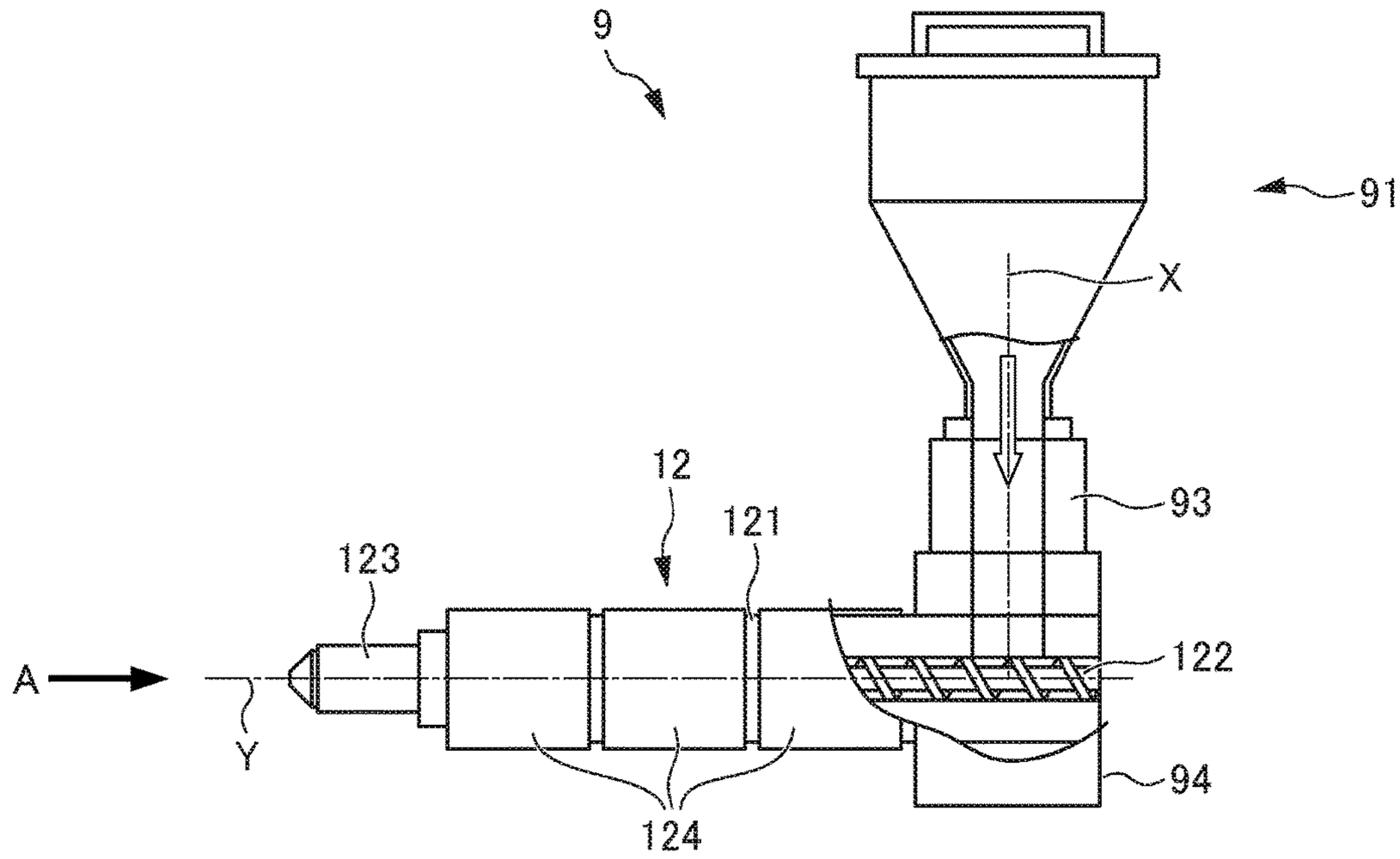
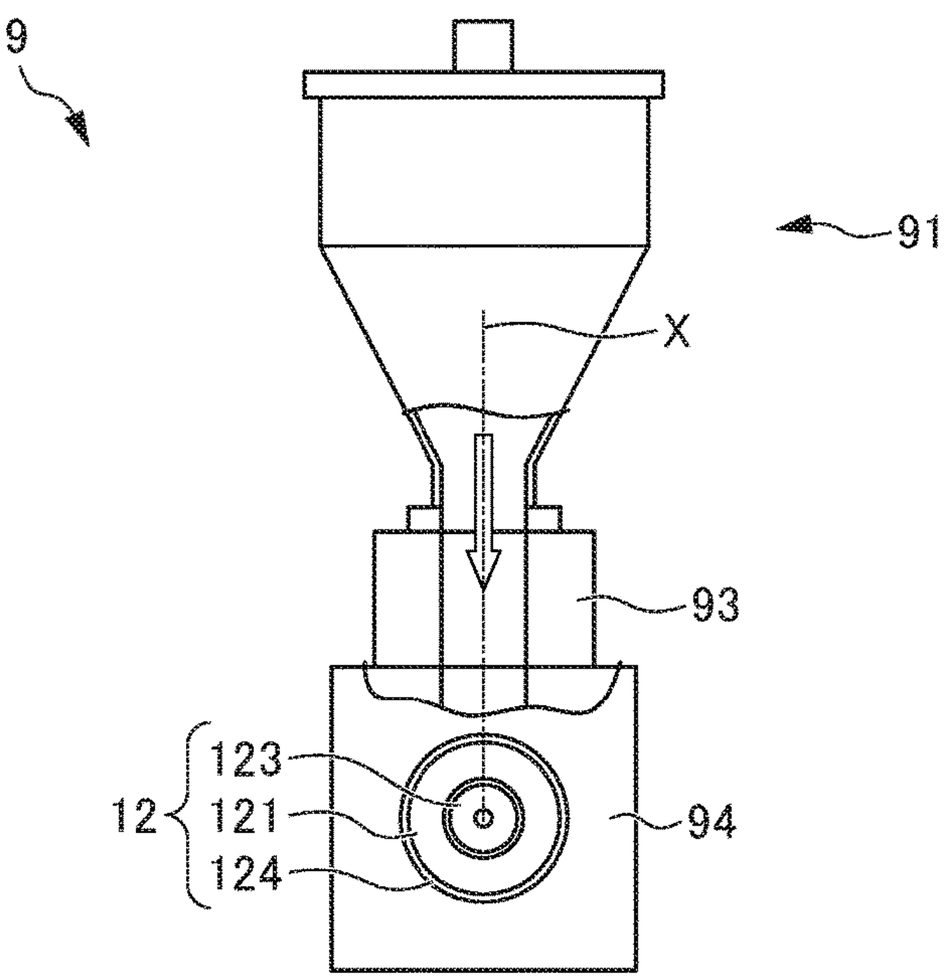


FIG. 8B



INJECTION DEVICE

This application is based on and claims the benefit of priority from Japanese Patent Application No. 2016-030301, filed on 19 Feb. 2016, the content of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to an injection device.

Related Art

Conventionally, an injection device that includes a hopper storing molding material such as resin pellets, and supplies the molding material from this hopper to an injection cylinder unit, has been known as an injection device used in injection molding machines. For example, injection devices that include a hopper applicable to both a horizontal-type injection device and a vertical-type injection device (for example, refer to Patent Document 1), or a hopper in which a waste vent for disposing surplus molding material (for example, refer to Patent Document 2) have been proposed.

Herein, FIG. **8**A is a view showing the configuration of a conventional, general injection device **9**, and FIG. **8**B is a view along the arrow A in FIG. **8**A. The injection device **9** is a horizontal-type injection device having an injection cylinder unit **12** that extends in a horizontal direction along the Y axis. The molding material naturally falls down by its own weight from the hopper **91** disposed above the injection cylinder unit **12** to be supplied inside of the injection cylinder unit **12** via the supply unit **93**. Between the supply unit **93** and a base end side of the injection cylinder unit **12**, a heat control jacket **94** that regulates the heat on the base end side is disposed. A heater **124** is wound around the outer circumference of a cylinder **121**, and the molding material is heated to melt by this heater **124**. The melted molding material is conveyed by a screw **122** disposed inside of the cylinder **121** until a nozzle **123** at a leading end side, and is injected from the nozzle **123** into a mold of a mold clamping device (not illustrated).

Patent Document 1: Japanese Unexamined Patent Application, Publication No. S55-25394

Patent Document 2: Japanese Unexamined Patent Application, Publication No.2015-98094

SUMMARY OF THE INVENTION

However, with the convention injection device, the supply direction of molding material is limited to one specific direction. More specifically, with a horizontal-type injection device like that shown in FIGS. **8**A and **8**B, while the supply direction of molding material is limited to vertically downwards along the X axis as shown by the arrow in the drawings, the supply direction of molding material has been limited to obliquely downwards with vertical-type injection devices. For this reason, with the conventional injection device, there is a limitation in the layout of the storage unit storing the molding material such as the hopper and the peripheral equipment, and thus the convenience has been low.

The present invention has an object of providing an injection device with high convenience by the degrees of freedom in the layout of the storage unit and peripheral equipment increasing, by way of including a supply unit that can change the supply direction of molding material.

An injection device (e.g., the injection device **1**, **2**, **3**, **4**A, **4**B, **5**A, **5**B, **5**C described later) according to the present

invention includes: a storage unit (e.g., the hopper **11**, **41** described later) that stores a molding material (e.g., the resin pellets described later); an injection cylinder unit (e.g., the injection cylinder unit **12** described later) that heats the molding material to melt, and then injects the molding material thus melted; and a supply unit (e.g., the supply unit **13**, **23**, **33** described later) having formed inside thereof a supply hole (e.g., the supply hole **131**, **331** described later) for supplying the molding material stored in the storage unit to the injection cylinder unit, in which the supply unit is fixed so that at least either of a position and orientation of an opening (e.g., the opening **132**, **232**, **332** on the hopper side described later) of the supply hole on a side of the storage unit is changeable relative to the injection cylinder unit.

It is preferable for the supply unit to be fixed to be pivotable around a predetermined pivot axis (e.g., the X**2** axis described later).

It is preferable for the supply hole to branch inside of the supply unit, and to have at least three openings (e.g., the openings **332**, **333**, **334** described later).

It is preferable for at least one of the openings to be used as a waste vent of molding material.

The injection device can further include: a heat control unit (e.g., the heat control jacket **14**, **24**, **44**, **54** described later) that is disposed between the supply unit and a base end side of the injection cylinder unit, and controls a temperature of the base end side of the injection cylinder unit.

The storage unit can also be provided to a drying device that dries the molding material or an automatic conveying device that automatically conveys the molding material to the supply unit.

According to the present invention, it is possible to provide an injection device with high convenience by the degrees of freedom in the layout of the storage unit and peripheral equipment increasing, by way of including a supply unit that can change the supply direction of molding material.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a view showing the configuration of an injection device according to a first embodiment;

FIG. **2**A is a view along the arrow A in FIG. **1**;

FIG. **2**B is a view showing the injection device according to the first embodiment, when changing a supply direction of a molding material;

FIG. **3** is a view illustrating a changing operation of the supply direction of molding material for the injection device according to the first embodiment;

FIG. **4** is a view illustrating a configuration of an injection device according to a second embodiment and a changing operation of the supply direction of molding material;

FIG. **5** is a view illustrating a configuration of an injection device according to a third embodiment and a changing operation of the supply direction of molding material;

FIG. **6**A is a view showing the configuration of an injection device according to a fourth embodiment;

FIG. **6**B is a view showing the configuration of an injection device according to a modified example of the fourth embodiment;

FIG. **7**A is a view illustrating the configuration of an injection device according to a fifth embodiment and a changing operation of the supply direction of molding material;

FIG. **7**B is a view showing the configuration of an injection device according to a modified example of the fifth embodiment;

FIG. **7**C is a view showing the configuration of an injection device according to a modified example of the fifth embodiment;

FIG. **8**A is a view showing the configuration of a conventional, general injection device; and

FIG. **8**B is a view along the arrow A in FIG. **8**A.

DETAILED DESCRIPTION OF THE INVENTION

Hereinafter, a first embodiment of the present invention will be explained in detail while referencing the drawings. It should be noted that, in the explanations of a second embodiment and after, the same reference symbols will be assigned for configurations shared with the first embodiment, and explanations thereof will be omitted.

First Embodiment

FIG. **1** is a view showing the configuration of an injection device **1** according to the first embodiment of the present invention. FIG. **2**A is a view along the arrow A in FIG. **1**.

The injection device **1** according to the first embodiment is used as an injection device of an injection molding machine including a mold clamping device (not illustrated) that clamps the mold and molds a resin article. The injection device **1** is a horizontal-type injection device in which an injection cylinder unit **12** described later extends in a horizontal direction along the Y axis (left/right direction in FIG. **1**). The injection device **1** heats resin pellets as the molding material to form molten resin, and injects this molten resin inside the mold of the mold clamping device.

The injection device **1** includes a hopper **11**, injection cylinder unit **12**, supply unit **13**, and heat-control jacket **14**.

The hopper **11** accommodates and stores the molding material inside thereof. In the hopper **11**, a lower part **112** has a vertically inverted slanted cone shape, and a leg part **113** is connected at the lower end thereof. The leg part **113** is provided to extend obliquely downwards, and a flange **113***a* formed at the bottom end thereof is connected to an oblique face part **13***a* of the supply unit **13** described later. As shown in FIG. **2**A, the hopper **11** is thereby not just above the supply unit **13** and heat control jacket **14**, but rather is arranged at a position displaced in the horizontal direction which is orthogonal to the Y axis, which is a central axis of the injection cylinder unit **12** (position displaced to left side from Y axis in FIG. **2**A).

The injection cylinder unit **12** heats resin pellets that are the molding material to make molten resin, and injects this molten resin into the mold of the mold clamping device. The injection cylinder unit **12** is provided to extend in the horizontal direction along the Y axis, which is the central axis thereof. The injection cylinder unit **12** is configured to include a cylinder **121**, a screw **122**, a nozzle **123** and a heater **124**.

The cylinder **121** has a cylindrical shape and extends in the Y-axis direction. The screw **122** described later is accommodated inside of the cylinder **121**, and the molding material is supplied to the base end side thereof. The screw **122** is arranged concentrically within the cylinder **121**. The screw **122** has helical blades on the outer circumference thereof. The screw **122** rotates by way of a rotating servo motor (not illustrated) with the Y axis as the axis of rotation, and moves inside of the cylinder **121** in the Y-axis direction by way of an injection servo motor (not illustrated). The molten resin inside of the cylinder **121** is thereby conveyed to the nozzle **123** described later.

The nozzle **123** is arranged at a leading end of the cylinder **121**. The nozzle **123** discharges the molten resin within the cylinder **121** into the mold of the mold clamping device by way of the screw **122**.

The heater **124** is wound around the outer circumferential face of the cylinder **121**. The heater **124** heats resin pellets inside of the cylinder **121** to make molten resin.

The supply unit **13** is arranged between the hopper **11** and the heat control jacket **14** described later. The supply unit **13** supplies the molding material stored in the hopper **11** to the injection cylinder unit **12**. The supply unit **13** is a substantially quadrangular prism shape, and has, at an upper part thereof, an oblique face part **13***a* connected to the bottom end flange **113***a* of the leg **113** of the hopper **11**. The oblique face part **13***a* functions as a connecting face part with the hopper **11**. In addition, the supply unit **13** has a flange **13***b* at a lower part thereof, and comes to be fixed by bolts **134** being fastened in bolt holes formed in this flange **13***b* and in bolt holes formed in the upper face of the heat control jacket **14** described later.

A supply hole **131** for supplying molding material to the injection cylinder unit **12** is formed at the inside of the supply unit **13**. The supply hole **131** is formed to penetrate the inside of the supply unit **13**. In more detail, the supply hole **131** extends obliquely downwards from an opening **132** on the hopper side formed in the oblique face part **13***a*, then curves and extends vertically downwards to reach an opening **133** on the heat control jacket side. In addition, this supply hole **131** is connected to an introducing hole **141** of the heat control jacket **14** described later.

In the present embodiment, the central axis of a portion of the supply hole **131** extending obliquely downwards is the X**1** axis, which matches the central axis of the leg of the hopper **11**, and the central axis of a portion extending vertically downwards is the X**2** axis (vertical axis), which matches the central axis of the introducing hole **141**. In addition, this X**1** axis and X**2** axis are intersecting each other. However, it is not limited thereto, and the central axis may deviate from each other.

The heat control jacket **14** is arranged between the supply unit **13** and the base end side of the injection cylinder unit **12**. The heat control jacket **14** adjusts the temperature at the base end side of the injection cylinder unit **12**. The base end side of the cylinder **121** is inserted inside of the heat control jacket **14**. In addition, the introducing hole **141** connected to the supply hole **131** of the supply unit **13** and for introducing the molding material into the cylinder **121** is formed inside of the heat control jacket **14**. A cooling passage (not illustrated) in which a cooling medium circulates is formed inside of the heat control jacket **14**, whereby the base end side of the injection cylinder unit **12** heated by the heater **124** is cooled to be temperature controlled.

In the injection device **1** equipped with the above configuration, the supply unit **13** is fixed to the heat control jacket **14** to be able to pivot with the X**2** axis (vertical axis) as a pivot axis. In other words, the position and orientation of the opening **132** on the hopper side of the supply hole **131** formed in the supply unit **13** are changed relative to the injection cylinder unit **12**, by removing the bolts **134**, temporarily detaching the supply unit **13** from the heat control jacket **14**, pivoting around the X**2** axis (vertical axis), and then fixing again by the bolts **134**. The injection device **1** thereby becomes able to change the supply direction of molding material.

Herein, FIG. **2**B is a view showing the injection device **1** when changing the supply direction of molding material. More specifically, FIG. **2**B shows the injection device **1**

when pivoting the supply unit **13** by 180 degrees around the X**2** axis (vertical axis) and then fixing. As shown in FIG. **2**B, the supply direction of the molding material indicated by the arrow in the drawing also pivots by 180 degrees, by causing the supply unit **13** to pivot by 180 degrees around the X**2** axis (vertical axis). In other words, prior to pivoting of the supply unit **13**, the supply direction of molding material was the E direction (obliquely downwards to right in FIG. **2**A), as shown in FIG. **2**A; whereas, after pivoting by 180 degrees of the supply unit **13**, it is changed to the W direction (obliquely downwards to left in FIG. **2**B) as shown in FIG. **2**B.

The changing operation of the supply direction of molding material for the injection device **1** will be explained in further detail by referencing FIG. **3**. Herein, FIG. **3** is a view illustrating the changing operation of the supply direction of the molding material for the injection device **1**. More specifically, FIG. **3** is a plan view of the injection device **1**, with the upper left in FIG. **3** showing a view along the B arrow in FIG. **2**A, and the upper right in FIG. **3** showing a view along the B arrow in FIG. **2**B. It should be noted that FIG. **3** is illustrated by omitting descriptions for the hopper **11** and injection cylinder unit **12**.

As shown in FIG. **3**, the flange **13***b* of the supply unit **13** has a square-ring shape, and the supply unit **13** is fixed to the heat control jacket **14** by four of the bolts **134** being respectively fastened to each of the bolt holes formed in the four corners thereof, and the bolt holes formed in the top face of the heat control jacket **14**. In the present embodiment, all of the bolt holes are arranged on the same circumference (on the circumference of circle C in FIG. **3**); therefore, it becomes possible to pivot the supply unit **13** in 90 degree increments around the X**2** axis (vertical axis) and fix with the bolts. As shown in FIG. **3**, the position and orientation of the opening **132** on the hopper side of the supply hole **131** thereby assume different positions and orientations rotated in 90 degree increments around the X**2** axis (vertical axis). In other words, the supply direction of molding material is changeable to switch to the E direction (state on upper left in FIG. **3**), S direction (obliquely downwards to left in FIG. **1**, state on lower right in FIG. **3**), W direction (state on upper right in FIG. **3**) and N direction (obliquely downwards to right in FIG. **1**, state on lower left in FIG. **3**), which are four different directions made by rotating by 90 degree increments around the X**2** axis (vertical axis).

The following effects are exerted according to the present embodiment.

In the injection device **1** according to the present embodiment, the supply unit **13**, in which the supply hole **131** for supplying the molding material stored in the hopper **11** into the injection cylinder unit **12** is formed thereinside, is fixed so that the position and orientation of the opening **132** on the hopper side of the supply hole **131** becomes changeable relative to the injection cylinder unit **12**. In more detail, the supply unit **13** is fixed so as to be pivotable step-wise (4 steps) around the X**2** axis (vertical axis).

Since it is thereby possible to change the supply direction of molding material step-wise (4 steps), it is possible to provide an injection device with high convenience by the degrees of freedom in layout of the storage unit such as the hopper **11** and the peripheral equipment increasing. In other words, a layout with more freedom according to the purpose of the molding operator is possible, and by arranging the storage unit such as the hopper **11** to bias to a position displaced in a horizontal direction orthogonal to the Y axis, which is the central axis of the injection cylinder unit **12** in order to change the supply direction of the molding material to the E direction or W direction, for example, an operator easily approaches the storage unit from outside of the device, and thus refilling of molding material is facilitated. In addition, since it is possible to ensure a wide space on the opposite side to the side to which the storage unit is biased, it is possible to ensure the installation space for peripheral device such as a retrieving robot is wide.

Second Embodiment

FIG. **4** is a view illustrating the configuration of an injection device **2** according to a second embodiment and a changing operation of the supply direction of molding material. It should be noted that FIG. **4** is illustrated by omitting descriptions for the hopper **11** and injection cylinder unit **12**.

Regarding the injection device **2** according to the second embodiment as shown in FIG. **4**, except for the configuration of the supply unit **23** and the positions of the bolt holes in the top face of the heat control jacket **24** differing compared to the injection device **1** according to the first embodiment, both are the same configuration.

The supply unit **23** of the injection device **2** has a substantially columnar shape, and has, at the upper part thereof, an oblique face part **23***a* connected to a flange **113***a* at a bottom end of the leg **113** of the hopper **11**. In addition, the supply unit **23** has an annular flange **23***b* at the lower part thereof. A supply hole similar to the supply unit **13** of the first embodiment is formed inside of the supply unit **23**.

As bolt holes, four arc-shaped elongated holes **235** extending in a circumferential direction are formed in the annular flange **23***b* as bolt holes. The four elongated holes **235** are arranged at equal intervals in the circumferential direction. By the bolts **134** respectively being inserted into each of these four elongated holes **235**, and being fasted to the bolt holes in the top face of the heat control jacket **24**, the supply unit **23** comes to be fixed.

In the injection device **2** equipped with the above configuration, the supply unit **23** is fixed to the heat control jacket **24** to be able to pivot with the X**2** axis (vertical axis) as the pivot axis, similarly to the first embodiment. In other words, the position and orientation of the opening **232** on the hopper side of the supply hole formed in the supply unit **23** are changed relative to the injection cylinder unit **12**, by removing the bolt **134**, temporarily detaching the supply unit **23** from the heat control jacket **24**, pivoting around the X**2** axis (vertical axis), and then fixing again by the bolt **134**. In addition, in the case of the pivot angle being small, specifically i.e. in the case of being less than the central angle of the arc-shaped elongated hole **235**, it may be pivoted in a state loosening the bolts **134**, without detaching the supply unit **23** from the heat control jacket **24**. In this way, the injection device **2** thereby becomes able to seamlessly change the supply direction of molding material.

The following effects are exerted according to the present embodiment.

In the injection device **2** according to the present embodiment, the supply unit **23** is fixed so as to be pivotable seamlessly relative to the injection cylinder unit **12**.

Since it is thereby possible to seamlessly change the supply direction of the molding material, it is possible to provide an injection device with higher convenience by the degrees of freedom in layout of the storage unit such as the hopper **11** and the peripheral equipment further increasing. In addition, in the case of the pivot angle being small, i.e. if less than the central angle of the arc-shaped elongated hole **235**, it is possible to make pivot without detaching the supply unit **23** from the heat control jacket **14**. For this

reason, as a result of the supply unit **23** itself functioning as a safety member, it is possible to reliably avoid a situation in which the finger of an operator is mistakenly involved into the rotating screw **122**, and thus the operational safety improves.

Third Embodiment

FIG. **5** is a view illustrating the configuration of an injection device **3** according to a third embodiment and a changing operation of the supply direction of molding material. More specifically, FIG. **5** is a view when looking at the injection device **3** from a leading end side of the injection cylinder unit **12**.

For the injection device **3** according to the third embodiment as shown in FIG. **5**, except for the configuration of the supply unit **33** differing compared to the injection device **1** according to the first embodiment, both are the same configuration.

More specifically, they differ in the point of only one oblique face part **13***a* being formed at the upper part in the supply unit **13** of the first embodiment; whereas, the supply unit **33** of the injection device **3** has a pair of oblique face parts **33***a*, **33***c* formed at the upper part thereof.

In addition, the supply hole **331** formed inside of the supply unit **33** of the injection device **3** differs from the supply hole **131** of the supply unit **13** of the first embodiment in the point of branching in the middle and having three openings. In more detail, the supply hole **331** branches into a portion extending obliquely downwards from an opening **332** formed in the oblique face part **33***a*, and a portion extending obliquely downwards from an opening **333** formed in the oblique face part **33***c*, and extends vertically downwards from this branch part to reach an opening **334** on the side of the heat control jacket.

In the present embodiment, the X**1** axis, which is the central axis of a portion extending obliquely downwards from the opening **332** formed in the oblique face part **33***a*, and the X**1**' axis, which is the central axis of a portion extending obliquely downwards from the opening **333** formed in the oblique face part **33***c*, are orthogonal to each other, and intersect with the X**2** axis (vertical axis), which is the central axis of a portion extending vertically downwards at the orthogonal point. However, it is not limited thereto, and the central axes may deviate from each other.

As shown in FIG. **5**, the supply unit **33** of the present embodiment has the two of the oblique face parts **33***a*, **33***c* functioning as connecting face parts with the hopper **111**; therefore, it becomes possible to switch the mounting position of the hopper **11** between the two. The position and orientation of the opening on the hopper side of the supply hole **331** is thereby changed relative to the injection cylinder unit **12**, and thus the supply direction of molding material becomes changeable. In other words, the supply direction of molding material is made changeable by switching between the W direction (obliquely downwards to left in FIG. **5**) and E direction (obliquely downwards to right in FIG. **5**), as shown in FIG. **5**.

The following effects are exerted according to the present embodiment.

The injection device **3** according to the present embodiment forms the supply hole **331** that branches in the middle to have the three openings **332**, **333**, **334** inside of the supply unit **33**, as well as forming the two oblique face parts **33***a*, **33***c* at the upper part of the supply unit **33**, and arranging the openings **332**, **333** in these oblique face parts **33***a*, **33***c*.

Since it is thereby possible to switch the supply direction of molding material between the W direction (obliquely downwards to left in FIG. **5**) and E direction (obliquely downwards to right in FIG. **5**), similar effects as the first embodiment are exerted. It should be noted that a lid may be provided for the opening on a side not used; however, it is possible to use as a supply port of other materials or additives (gases, liquids, solids). Alternatively, it can also be used as a waste vent of molding material that has become surplus.

Fourth Embodiment

FIG. **6**A is a view showing the configuration of an injection device **4**A according to a fourth embodiment. For the injection device **4**A according to the fourth embodiment as shown in FIG. **6**A, except for the configuration of the hopper **41** and the configuration of the heat control jacket **44** differing compared to the injection device **1** according to the first embodiment, both are the same configuration.

In the hopper **41**, the lower part **112** of inverted oblique cone shape of the hopper **11** of the first embodiment is changed to a lower part **412** of inverted cone shape without eccentricity. In addition, in the hopper **41**, the leg part **113** extending obliquely downwards of the hopper **11** of the first embodiment is changed to a leg part **413** extending vertically downwards. In other words, the molding material naturally falls vertically downwards with the hopper **41** of the present embodiment.

In the heat control jacket **14** of the first embodiment, the supply unit **13** is installed and fixed to an upper face thereof; whereas, in the heat control jacket **44** of the present embodiment, an oblique face part **44***a* is formed at an upper part on an opposite side to the side of the injection cylinder unit **12**, and the supply unit **13** is obliquely installed and fixed to this oblique face part **44***a*. For this reason, the introducing hole **441** formed inside of the heat control jacket **44** becomes a configuration obliquely extending in the X**2** axis direction.

Herein, FIG. **6**B is a view showing the configuration of an injection device **4**B according to a modified example of the fourth embodiment. This injection device **4**B corresponds to the device made by pivoting the supply unit **13** of the aforementioned injection device **4**A by 180 degrees with the X**2** axis (central axis of introducing hole **441**) as the pivot axis, to change the injection cylinder unit **12** from horizontal type to vertical type. In this way, with the injection device **4**A of the present embodiment, switching between a horizontal-type injection device and vertical-type injection device becomes possible by pivoting the supply unit **13** around the X**2** axis.

The following effects are exerted according to the present embodiment.

With the injection devices **4**A and **4**B according to the present embodiment, the hopper **41** is made a configuration that is an inverted cone whereby the molding material naturally falls vertically downwards, and the supply unit **13** having a pivot function is obliquely fixed relative to the heat control jacket **44**.

It is thereby possible to change the position and orientation of the opening **132** on the hopper side of the supply hole **131** formed in the supply unit **13**, relative to the injection cylinder unit **12**, by pivoting the supply unit **13** around the X**2** axis, and thus possible to change the supply direction of molding material; therefore, the same effects as the first embodiment are exerted. Additionally, switching between a horizontal-type injection device and a vertical-type injection device becomes possible, and thus an injection device with high convenience applicable as either horizontal type or vertical type is obtained. In addition, by adjusting the fixing angle of the supply unit **13** relative to the heat control jacket **44**, for example, it is not limited to horizontal type or vertical

type, and it is possible to apply to an injection device in which the injection cylinder unit **12** is arranged to extend in an oblique direction.

Fifth Embodiment

FIG. **7**A is a view illustrating the configuration of an injection device **5**A according to a fifth embodiment, and a changing operation of the supply direction of molding material. For the injection device **5**A according to the fifth embodiment as shown in FIG. **7**A, except for the orientation of the supply unit **33** and configuration of the heat control jacket **54** differing compared to the injection device **3** according to the third embodiment, both are the same configuration.

More specifically, the supply unit **33** of the injection device **5**A corresponds to one made by pivoting the supply unit **33** of the injection device **3** according to the third embodiment by 90 degrees around the X**2** axis (vertical axis) and fixing.

In addition, in the heat control jacket **54**, the point of the introducing hole **541** inside thereof being formed to extend obliquely downwards (X**2**' axis direction in FIG. **7**A) from the top face of the heat control jacket **54** differs from the introducing hole **141** of the injection device **3**, which extends vertically downwards.

As shown in FIG. **7**A, the supply unit **33** of the present embodiment has the two oblique face parts **33***a*, **33***c* functioning as connecting face parts with the hopper **11**, similarly to the third embodiment; therefore, it becomes possible to switch the mounting position of the hopper **11** between the two. The position and orientation of the opening on the hopper side of the supply hole **331** are changed relative to the injection cylinder unit **12**, and thus the supply direction of the molding material becomes changeable. In other words, in the present embodiment, the supply direction of the molding material becomes changeable by switching between the S direction (obliquely downwards to left in FIG. **7**A) and the N direction (obliquely downwards to right in FIG. **7**A), as shown in FIG. **7**A.

Herein, FIG. **7**B is a view showing the configuration of an injection device **5**B according to a modified example of the fifth embodiment. This injection device **5**B corresponds to a device made by pivoting the orientation of the hopper **11** in the aforementioned injection device **5**A with the X**1** axis (central axis of leg **113**) by 180 degrees as the pivot axis, to change the injection cylinder unit **12** from horizontal type to vertical type. In this way, the injection device **5**A of the present embodiment pivots the hopper **11** around the X**1** axis, whereby switching between a horizontal-type injection device and a vertical-type injection device becomes possible.

In addition, FIG. **7**C is a view showing the configuration of an injection device **5**C according to a modified example of the fifth embodiment. The injection device **5**C corresponds to a device made by pivoting the supply unit **33** with the horizontal direction orthogonal to the Y axis, which is the central axis of the injection cylinder unit **12** (direction orthogonal to FIG. **7**A sheet plane) as the pivot axis, as well as connecting the opening **332** to the introducing hole **541** of the heat control jacket **54**, and connecting the opening **334** to the hopper **11**, in the aforementioned injection device **5**A. In this way, in the injection device **5**C of the present embodiment pivots, changing of the supply direction of the molding material becomes possible, by pivoting the supply unit **33** with the horizontal direction, which is orthogonal to the Y axis that is the central axis of the injection cylinder **12**, as the pivot axis.

The following effects are exerted according to the present embodiment.

In the injection devices **5**A to **5**C according to the present embodiment, in addition to the same effects as the third embodiment being exerted by providing the supply unit **33**, switching between a horizontal-type injection device and a vertical-type injection device becomes possible by changing the orientation of the hopper **11**, and thus an injection device with high convenience that is applicable as either horizontal type or vertical type is obtained.

In addition, with the injection devices **5**A to **5**C according to the present embodiment, it is possible to change the supply direction of the molding material even by pivoting the supply unit **33** with the horizontal direction orthogonal to the Y axis, which is the central axis of the injection cylinder unit **12**, as the pivot axis, and thus it is possible to provide an injection device with higher convenience. It should be noted that a lid may be provided for the opening on a side not used; however, it is possible to use as a supply port of other materials or additives (gases, liquids, solids). Alternatively, it can also be used as a waste vent of molding material that has become surplus.

It should be noted that the present invention is not to be limited to the above-mentioned first embodiment to fifth embodiment, and that modifications and improvements of a scope that can achieve the object of the present invention are also encompassed by the present invention.

In all of the above-mentioned embodiments, although the position and orientation of the opening on the hopper side of the supply hole are configured to be changeable, it is not limited thereto. For example, it may be made a configuration in which only the orientation of the opening on the hopper side of the supply hole is changeable.

In addition, in all of the above-mentioned embodiments, although a hopper that supplies the molding material to the injection cylinder unit by allowing to naturally fall downwards from its own weight is used as a storage unit, it is not limited thereto. For example, a drying device that dries the molding material may be used in place of the hopper. In addition, an automatic conveying device that is connected to a resin tank and has a loader function of automatically conveying the molding material to the supply unit may be used.

Furthermore, in all of the above-mentioned embodiments, although a configuration is made arranging the heat control jacket between the supply unit and the base end side of the injection cylinder unit, it is not limited thereto. For example, the injection cylinder unit and heat control jacket may be integrated to provide a heat control unit having the heat control function in the injection cylinder unit itself.

EXPLANATION OF REFERENCE NUMERALS

1, **2**, **3**, **4**A, **4**B, **5**A, **5**B, **5**C injection device

11, **41** hopper (storage unit)

12 injection cylinder unit

13, **23**, **33** supply unit

14, **24**, **44**, **54** heat control jacket (heat control unit)

131, **331** supply hole

132, **232**, **332** opening on hopper side (opening on storage unit side)

X**2** pivot axis

What is claimed is:

1. An injection device, comprising:

a storage unit that stores a molding material;

an injection cylinder unit that heats the molding material to melt, and then injects the molding material thus melted; and

a supply unit having formed inside thereof a supply hole for supplying the molding material stored in the storage unit to the injection cylinder unit, wherein

the injection cylinder unit is configured to include a cylinder and a screw arranged concentrically within the cylinder,

the supply unit is fixed to be pivotable around a predetermined pivot axis so that at least either of a position and orientation of the storage unit is changeable relative to the injection cylinder unit, and

the supply hole branches inside of the supply unit, and has at least three openings.

2. The injection device according to claim 1, wherein at least one of the openings is a waste vent of molding material.

3. The injection device according to claim 1, further comprising a heat controller that is disposed between the supply unit and a base end side of the injection cylinder unit, and controls a temperature of the base end side of the injection cylinder unit.

4. The injection device according to claim 1, wherein the storage unit is provided to a dryer that dries the molding material or an automatic conveyer that automatically conveys the molding material to the supply unit.

5. The injection device according to claim 1, wherein in any orientation or position of the supply hole, the storage unit is configured to supply molding material to the injection cylinder unit.

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